CLAIMS

1. A method for measuring a flow rate (v) or a mass flow of a fluid (3), in particular for measuring hot water supply in the private, public or industrial sector, in which the fluid (3) is guided over a sensor element (1), which has a heating means (1a) for inducing temperature changes and a sensor means (1b) for determining its temperature, wherein at least from time to time the heating means (1a) is operated with a heating power (P) in the form of heating pulses and a flow-dependent threshold value time (t_S) is measured at the sensor means (1b) until a preset temperature threshold value (T_S) is reached, characterised in that during at least some of the heating pulses (7) a non-constant heating power (P) with a substantially sublinear build-up dynamics (P(t)) as a function of time (t) is selected in order to at least partially compensate a nonlinear behaviour of the threshold value time (t_S) as a function of the flow rate (v).

2. The method as claimed in claim 1, characterised in that the build-up dynamics (P(t)) as a function of the time (t) and, if required, of the flow rate (v) to be measured is varied itself such that the threshold value time (t_S) is a linear function of the flow rate (v) at least on discrete flow rate values (v_i).

3. The method as claimed in any one of the preceding claims, characterised in that the build-up dynamics (P(t)) is selected to be proportional to t^m, wherein m=an exponent dependent on a Reynolds number of the fluid (3) which is lower than 1, in particular $m \leq 0.5$ and particularly preferred

$m=0.466$ for a Reynolds number of the fluid (3) between 40 and 4000.

4. The method as claimed in any one of the preceding claims, characterised in that the build-up dynamics ($P(t)$) is selected to be proportional to a time-independent amplitude factor $(1+R_S/R_I)^{-1}$, wherein R_S is a first thermal transfer resistance between the heating means (1a) and a surface (10) of the sensor element (1) and $R_I=(h\bullet A)^{-1}$ is a second thermal transfer resistance between the surface (10) of the sensor element (1) and the fluid (3), wherein h is a flow-dependent heat transfer coefficient between the sensor element (1) and the fluid (3) and A is a contact surface between the sensor element (1) and the fluid (3).

5. The method as claimed in claims 3 and 4, characterised in that a cylindrical sensor element (1), against which the fluid (3) is transversely flown, is selected with a heat transfer coefficient h proportional to v^m and with a second thermal transfer resistance $R_I=\gamma\bullet v^{-m}$, γ being a constant.

6. The method as claimed in claims 3 and 4, characterised in that
   a) in a first step discrete values of the flow rate (v_i) are selected and corresponding build-up dynamics $P_i(t)$ of the heating power are determined, wherein $i=1, 2, 3, \ldots$ is an index,
   b) in a second step a set of calibration curves (8) of the threshold value time (t_S) as a function of the flow rate (v) is determined for the build-up dynamics ($P_i(t)$) and

c) in a third step, on account of a previously measured flow rate or based on a-priori information about the presumed flow rate, a preferred calibration curve (8) is selected according to a desired measuring precision for the flow rate (v) and according to a desired measuring duration (t_S), and is used to determine the flow rate (v), or

d) in a third step, starting from the calibration curve (8) associated with the lowest flow rate value ($v_{i=1}$) and rising successively to higher flow rate values ($v_{i>1}$) or by estimating in a single step, a preferred calibration curve (8) is determined according to a desired measuring precision for the flow rate (v) and according to a desired measuring duration (t_S), and is used to determine the flow rate (v).

7. The method as claimed in claim 6, characterised in that a number and distribution of the calibration curves (8) are selected according to a desired measuring resolution and to a desired measuring range of the flow rate (v).

8. The method as claimed in claims 3 and 4, characterised in that $R_S/R_I<1$, preferably $R_S/R_I<0.1$ and particularly preferred $R_S/R_I<0.01$, and a heating power factor P_0 are selected and the threshold value time (t_S) is calculated as an exact linear function of the flow rate (v) according to an equation

$t_S(v) = (T_S - T_F)^{1/m} \bullet (P_0 \bullet \gamma)^{-1/m} \bullet v$,

wherein γ is a constant and T_F is an undisturbed fluid temperature.

9. A device for carrying out the method as claimed in any one of the preceding claims, comprising a sensor element (1) with a heating means (1a) and a sensor means (1b) for thermal measuring in a fluid (3) and a control and evaluating processor unit (2) with a heating control (2a) for generating heating pulses (7) for the heating means (1a) and a measuring device (2b) for evaluating the thermal measurement and for determining a flow rate (v) or a mass flow from a flow-dependent threshold value time (t) until a preset temperature threshold value (T_S) at the sensor means (1b) is reached, characterised in that

a) the heating control (2b) comprises means for generating a non-constant heating power (P) with a substantially sublinear build-up dynamics (P(t)) as a function of the time (t), and

b) the control and evaluating processor unit (2) has means for at least partial compensation of a nonlinear behaviour of the threshold value time (t_s) as a function of the flow rate (v).

10. The device as claimed in claim 9, characterised in that

a) the control and evaluating processor unit (2) comprises hardware and/or software for generating a build-up dynamics (P(t)) proportional to t^m and/or to a time-independent amplitude factor $(1+R_S/R_I)^{-1}$, wherein t is a time variable, m is an exponent dependent on a Reynolds number of the fluid (3), R_S is a first thermal transfer resistance between the heating means (1b) and a surface (1a) of the sensor element (1), $R_I=(h\bullet A)^{-1}$ is a second thermal transfer

resistance between a surface (10) of the sensor element (1) and the fluid (3), h is a flow-dependent heat transfer coefficient between the sensor element (1) and the fluid (3) and A is a contact surface between the sensor element (1) and the fluid (3) is and/or

b) the control and evaluating processor unit (2) comprises calibration means (2c) for carrying out the first and second step as claimed in Claim 6.

11. The device as claimed in any one of claims 9 to 10, characterised in that

a) the sensor element (1) has an electric heating wire (1a, 1b) with a temperature-dependent resistance, which can be operated simultaneously as heating means (1a) and as sensor means (1b) and/or

b) the sensor element (1) has a heat capacity C_S and a first thermal transfer resistance R_S between the heating means (1b) and a surface (10) of the sensor element (1), wherein the threshold value time or measuring duration is $t_S>C_S \bullet R_S$, in particular $t_S>10 \bullet C_S \bullet R_S$, and/or

c) the sensor element (1) has a cylindrical shape with a diameter (d) and which has, when the fluid (3) flows laterally against it with the flow rate (v), has by approximation a flow-dependent heat transfer coefficient $h=\lambda/d \cdot 1.11 \cdot C \cdot Pr^{0.31} \bullet Re^m$, wherein λ is a heat conductivity of the fluid (3), C is a parameter and m is an exponent, which depend on a Reynolds number Re of the fluid (3), and Pr is a Prandtl number of the fluid (3).